# Cross-Cultural Sex Differences in Post-Conflict Affiliation following Sports Matches

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**Summary**

The nature of ancestral human social structure and the circumstances in which men or women tend to be more cooperative are subjects of intense debate. The male warrior hypothesis proposes that success in intergroup contests has been vital in human evolution and that men therefore must engage in maximally effective intragroup cooperation [1-3]. Post-conflict affiliation between opponents is further proposed to facilitate future cooperation [4] which has been demonstrated in non-human primates [5] and humans [6]. The sex that invests more in post-conflict affiliation therefore should cooperate more. Supportive evidence comes from chimpanzees, a close genetic relative to humans that also engages in male intergroup aggression [7]. Here we apply this principle to humans by testing the hypothesis that among members of a large community, following a conflict males are predisposed to be more ready than females to repair their relationship via friendly contact. We took high-level sports matches as a proxy for intragroup conflict, because they occur within a large organization and constitute semi-naturalistic, standardized, aggressive and intense confrontations. Duration or frequency of peaceful physical contacts served as the measure of post-conflict affiliation because they are strongly associated with pro-social intentions [8,9]. Across tennis, table tennis, badminton, and boxing with participants from 44 countries, duration of post-conflict affiliation was longer for males than females. Our results indicate that unrelated human males are more predisposed than females to invest in a behavior, post-conflict affiliation, that is expected to facilitate future intragroup cooperation.

**Results**

Sports matches were located following a standardized procedure (Supplemental Information). For every match, two coders measured duration of post-conflict affiliation in hundredths of seconds, and their measurements were averaged. Reliability was calculated by correlating coders' measures, producing $r$ (78) = .88 for tennis; $r$ (23) = .95 for table tennis, $r$ (23) = .93 for badminton, and $r$ (48) = .92 for boxing. Because the data were positively skewed and outliers exerted strong effects, we applied a natural log transformation to duration of post-conflict affiliation, then fit the data using two regression models. In the first Linear Mixed Model (LMM), winner's and loser's countries were entered as random effects to determine whether these were biasing the effect of sex. A second Ordinary Least Squares (OLS) regression then was conducted excluding players' countries. In all cases, the two models provided similar findings, so we conclude that players' countries did not influence the results.

For tennis, we located 40 male and 40 female singles tournament matches on youtube and the Australian Open vault, including 160 unique players from 34 primarily Western countries. To predict duration of post-conflict affiliation, sex of players, winner's and loser's countries, year of match, difference in players' rankings, round number in the tournament, and total number of sets played were analyzed first with a LMM including players' countries, then with a simple OLS (Tables 1 and 2). Both models provided similar results (last row of Table 1). Only sex was significant, with males' engaging in longer durations of post-conflict affiliation than females. Because player's ranks were unavailable before 1973, six matches initially were not included. Adding these matches into the models by excluding rank difference produced similar results (bottom of Table 1). Figure 1 displays the duration of post-conflict affiliation ranked in order from shortest to longest for all matches and shows that males engage in longer durations than females (Fig. 1A).

Whereas all opponents shook hands following a match, additional touches occurred sporadically. Whether the winner touched the loser with one arm, the loser touched the winner with one arm, or the winner and the loser embraced with two arms or kissed was recorded by each coder [agreement on 75/80 matches for the winner touching the loser, 77/80 matches for the loser touching the winner, and 80/80 matches for the embrace or kiss]. A final measure was calculated consisting of whether any physical contact in addition to the handshake occurred between the two players coded as 0 or 1 (agreement on 78/80 matches). Each coder's records produced the same results; only one coder's ratings are included.

Results showed that in significantly more male (17/40 or 42.5%) than female matches (5/40 or 12.5%), the winner touched the loser's body with one arm, ($X^2(1) = 9.03$, $p = .003$). Further, in significantly more male (9/40 or 22.5%) than female matches (1/40 or 2.5%), the loser touched the winner's body with one arm, ($X^2(1) = 7.31$, $p = .007$). There were no sex difference in two-armed embraces or kisses (5/40 female matches or 12.5% versus 1/40 male matches or 2.5%), Fisher's exact test $p = .20$. Overall, in significantly more male matches (21/40 or 52.5%) versus female matches (8/40 or 20%), an additional physical contact occurred, $X^2(1) = 9.14$, $p = .002$.

Choice of matches uploaded to youtube may introduce bias. In contrast, the International Table Tennis Foundation (ITTF) provides a more systematic sample in its online vault which contains all table tennis tournament matches from the past three years. Every singles finals match containing unique players was included from the vault, producing 12 male and 13 female table tennis matches with players from 17 countries, half of whom came from China or Japan. To predict post-conflict duration, sex of players and winner and loser's countries were entered into a LMM, then just sex was included in an OLS. Both models provided similar results, and only sex

was significant, with males' engaging in longer durations of post-conflict affiliation than females (Tables 1 and 2 and Fig. 1B).

For table tennis, an additional instance of physical contact besides the handshake occurred in four matches. All were male matches, so that 4/12 or 33% of male matches contained an additional contact, whereas none of the female matches did, ($X^2(1) = 4.80$, $p = .028$). (One of the coders also recorded an additional touch in a fifth male match, increasing the size of the effect.)

The Badminton Link vault also provides an unbiased sample of every badminton tournament match from the past three years. All finals and semi-finals matches containing unique players were included yielding 15 male and 10 female matches from 14 primarily East Asian countries. The same analyses were conducted as for table tennis (Tables 1 and 2 and Fig. 1C). Again, both models provided similar results, and only sex was significant, with males' engaging in longer durations of post-conflict affiliation than females. No additional instances of physical contact were visible.

Finally, 25 male and 25 female boxing matches were located on youtube, including boxers from 29 primarily Western countries, with almost half of the men and the women from the United States. The same analyses were conducted as for badminton (Tables 1 and 2 and Fig. 1D). Again, both models provided similar results, and only sex was significant, with males' engaging in longer durations of post-conflict affiliation than females. Due to the small size of the ring and the large number of individuals interacting with boxers following a match, type of physical contact could not be coded, only whether boxers' bodies touched.

To illustrate the sex difference, for each sport we set the median female duration of peaceful post-conflict physical contact to 100%, then depicted the male median relative to that.

Figure 2 depicts the percentage of males' median duration of physical contact as a function of females' median physical contact across the four sports (Fig. 2).

**Discussion**

Based on the male warrior hypothesis, we hypothesized that regardless of degree of familiarity, human males who are members of the same community are more predisposed than females to repair conflicts with unrelated same-sex individuals. We regard high level competitors in a given sport as being members of a community given that they all abide by the same organizational rules, and are either in shared social networks or have many individuals in common in their social networks.

Across four sports involving participants from 44 countries, male opponents spent significantly more time than female opponents in post-conflict affiliation. Boxing provides a striking comparison to racquet sports as it more closely resembles natural physical combat. Boxing often leads to wounds and pain, and the greater strength of males suggests that they can impose greater damage on each other than females do. Yet the sex difference in boxing was particularly strong, showing no trend for more intense conflicts to lead to reduced post-conflict affiliation. The total duration of affiliative contact was always only a few seconds, as were the average differences in duration of contact between males versus females, but short durations and small absolute differences nevertheless are expected to convey critically different information. For example, quickly brushing fingers, fully clasping hands, adding a soft clap of the back, and embracing are ordered in terms of increasing duration and communicate increasing intensity of positive affect but differ by less than 1-2 seconds in duration. Furthermore we found that the sex differences in duration of affiliative contact were paralleled by a sex difference in the number of

physical contacts (i.e. touching the other's arm in tennis in addition to the handshake), and number of conciliatory gestures is linked with forgiveness in humans [6].

The findings are striking in light of data on general sex differences in same-sex physical contact which demonstrate that overall female-female touching is equal to or more frequent than male-male touching [10,11]. Therefore we might have expected that following a conflict, women would touch each other at least as much as men did, yet men touched each other longer than women did.

Limitations of our study merit consideration. First, women may be less invested than men in sports for reasons such as reduced interest, lesser financial compensation or lower prestige, which could weaken their incentive to repair a conflict and participate in the future. According to this objection, in contests more relevant for survival or reproductive success such as in conflict over food or a potential mate, males would be less likely to reconcile than females. The sports context however is not unique. In work contexts, following competition, but not cooperation, female but not male co-workers report damage to their relationships, regardless of level of familiarity [12]. Following divorce, men tend to more easily form peaceful relationships with their former wives' new spouses than vice-versa [13,14]. In shared residences, male collegiate roommates were less likely than female roommates to become embroiled in irreconcilable conflicts that resulted in changing roommates [15]. Irreconcilable conflicts similarly are more likely to lead to the disintegration of the activities and social groups of girls than boys [16,17]. Despite more frequent overt conflicts, boys also are more likely than girls to expand friendship networks to include less familiar same-sex peers [17,18] and are less likely than girls to believe that hypothetical conflicts with a same-sex friend would damage the relationship [19,20].

A second potential limitation is that our coding might have missed important information that could have influenced the conclusions. Thus, women might be more likely than men to reconcile verbally, with non-contact gestures, or later in private. Verbal interaction occurred so rarely however that it is unlikely to have influenced the findings. Further, because physical contact generally exerts primacy over other sensory modalities in communicating intent [21], information conveyed through physical contact should either correlate with or supersede other communication modalities. Finally, it is rare for women to exchange emotionally important information privately with those with whom they are not closely bonded [1], so it unlikely that female opponents reconciled in isolation.

Third, concerns about public reputation could in theory contribute to differential investment in post-conflict affiliation. However differences among our sports argue against this idea. The finals of grand slam tennis tournaments draw thousands of spectators, whereas table tennis draws only a few dozen, with boxing and badminton attracting intermediate numbers; yet the magnitude of the sex difference was greatest in table tennis and boxing (Fig. 2). Further, whereas the racquet sports matches came from high level international tournaments, boxing matches came from primarily American tournaments. Thus there was no relation between the size or global diversity of the crowd and the sex difference in post-conflict affiliation.

Finally, an alternative interpretation of our results is that women intuitively feel more strongly bonded to same-sex individuals than men do, thereby obviating the need for reconciliation following a conflict. However this interpretation is not supported by the previously described studies showing that human females experience greater difficulty reconciling conflicts with unrelated same-sex peers than males do.

The results provide support for the conclusion that human males tend to be more concerned than females with expressing affiliative behaviors following conflicts with unrelated same-sex peers. This may help to account for greater male cooperation in many types of non-kin-based organizations, such as government, business, and religious institutions [14]. This sex-biased pattern of investment in groups appears cross-culturally beginning in middle childhood when boys tend to engage in larger and more interconnected groups than girls who prefer dyadic bonds [22].

Post-conflict affiliation is proposed to facilitate future cooperation by repairing damage to relationships [4]. For humans, this would be critical for success in future inter-group contests. By supporting the male-warrior hypothesis, the evidence that human males spend more time than females in post-conflict affiliation with same-sex peers suggests that cooperation among males within a society, even without a close social relationship, has been a characteristic feature of human evolution.

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**Author Contributions**

J.F.B. Methodology, Original Draft, Funding Acquisition; J.F.B. and R.W.W. Conceptualization, Review and Editing.

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Table 1

**Sex differences in post-conflict affiliation in each sport.**[a]

| | Tennis[b] | | Badminton | | Boxing | | Table Tennis | |
|---|---|---|---|---|---|---|---|---|
| | LMM | OLS | LMM | OLS | LMM | OLS | LMM | OLS |
| (Intercept) | 7.76 | 7.76 | 4.43*** | 4.35*** | 5.67*** | 5.61*** | 3.32*** | 3.32*** |
| | (13.58) | (13.58) | (0.20) | (0.18) | (0.18) | (0.15) | (0.16) | (0.16) |
| Sex (male) | 0.29* | 0.29* | 0.46* | 0.60* | 0.95*** | 0.95*** | 1.08*** | 1.08*** |
| | (0.14) | (0.14) | (0.21) | (0.24) | (0.21) | (0.21) | (0.23) | (0.23) |
| Year | -0.00 | -0.00 | | | | | | |
| | (0.01) | (0.01) | | | | | | |
| Rank difference | -0.00 | -0.00 | | | | | | |
| | (0.00) | (0.00) | | | | | | |
| Round number | 0.02 | 0.02 | | | | | | |
| | (0.03) | (0.03) | | | | | | |
| Total sets | 0.00 | 0.00 | | | | | | |
| | (0.08) | (0.08) | | | | | | |
| AIC | 162.49 | | 51.73 | | 125.27 | | 55.43 | |
| BIC | 183.22 | | 57.83 | | 134.83 | | 61.52 | |
| Log Likelihood | -72.24 | | -20.87 | | -57.63 | | -22.71 | |
| Num. obs. | 74 | 74 | 25 | 25 | 50 | 50 | 25 | 25 |
| Num. groups: loser_country | 30 | | 10 | | 17 | | 11 | |
| Num. groups: winner_country | 28 | | 11 | | 21 | | 12 | |
| Var: loser_country (Intercept) | 0.00 | | 0.15 | | 0.10 | | 0.00 | |
| Var: winner_country (Intercept) | 0.00 | | 0.00 | | 0.00 | | 0.00 | |
| Var: Residual | 0.28 | | 0.20 | | 0.50 | | 0.34 | |
| $R^2$ | | 0.09 | | 0.22 | | 0.29 | | 0.48 |
| Adj. $R^2$ | | 0.03 | | 0.18 | | 0.28 | | 0.46 |
| RMSE | | 0.53 | | 0.58 | | 0.75 | | 0.58 |
| LRT *p*-value | 1 | | 0.18 | | 1 | | 1 | |

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$

[a] Linear Mixed Model (LMM) in first and Ordinary Least Squares (OLS) in second columns. Fixed effects estimates (standard errors) above mid-line; Goodness of fit statistics by model with random effects estimates below. Likelihood Ratio Test (LMM > OLS) in final line.

[b] n = 74 with rank difference information. When rank difference excluded from models, $n = 80$, sex (male) Estimate = .32 for both models, $R^2 = .12$, adjusted $R^2 = .07$.

Table 2

**Sequential Bonferroni adjusted *p*-values for sex differences in OLS models.**

| Sport | *p*-value | *p*-value (adj) |
|---|---|---|
| Tennis [a] | 0.035 | 0.038 |
| Table Tennis | 0.00012 | 0.00036 |
| Badminton | 0.019 | 0.038 |
| Boxing | 0.000048 | 0.00019 |

*n* = 74. Excluding rank differences from the model, *n* = 80, *p* = 0.018 and adjusted *p* = 0.036.

## Figure Legends

Figure 1. **Duration of Post-Conflict Affiliation of each Match**. Duration of peaceful post-conflict affiliation ordered from shortest to longest within each sport by sex: A) 40 male and 40 tennis matches B) 12 male and 13 female table tennis matches, C) 15 male and 10 female badminton matches, and D) 25 male and 25 female boxing matches.

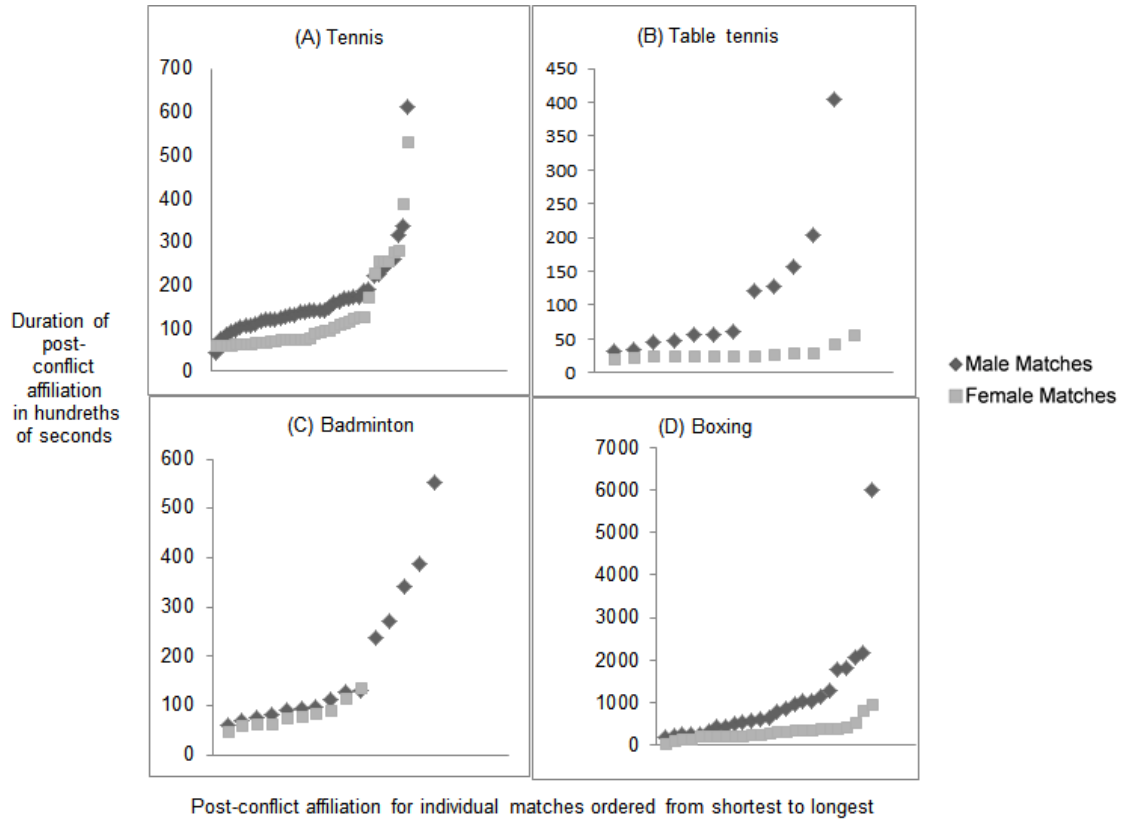

Figure 2. **Males' Median Duration of Post-Conflict Affiliation as a Function of Females' Duration.** Percentage of males' median peaceful physical post-affiliation physical contact as a function of females' median duration of post-affiliation physical contact with females' duration set to 100% for each sport (females' actual median duration for tennis =.83s; for table tennis =.25s; for badminton = .77s; for boxing = 2.76s).